MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023 (TERM ID 2220)

PCM0016 – CHEMISTRY

(All sections / Groups)

14 JULY 2023
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [30 MARKS]

(a) 30 grams of NO_2 is allowed to react with 10 grams of water. The reaction produces HNO_3 and NO.
[Atomic mass: H = 1.0; N = 14.0; O = 16.0]

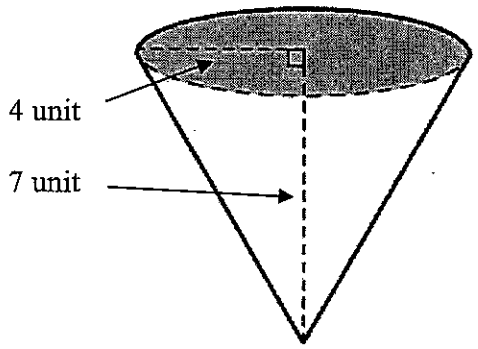
(i) Complete and balance the equation. [2 marks]
(ii) Find the limiting reagent. [4 marks]
(iii) Find the mass of HNO_3 that can be theoretically formed. [2 marks]
(iv) If the percent yield of HNO_3 is 85%, find the actual mass of HNO_3 [2 marks]

(b) Complete the table below by writing the chemical formulae, naming the compounds and identify the compounds as ionic or molecular:

Chemical formula	Name of compound	Ionic or covalent?
Na_2O	(i)	(ii)
(iii)	Iron (III) chloride	(iv)
IF_7	(v)	(vi)
(vii)	Ammonium hydroxide	(viii)

[4 marks]

(c) A semi flexible container as figure below contains an ideal gas at 293.15 K. The gas is then heated at constant pressure until temperature remains at 327 K. Determine the area of the cone base after the gas is heated (assume that the cone height is rigid and cannot expand).
[Volume of a cone = $(1/3)\pi r^2 h$, area of a circle = πr^2]



[4 marks]

Continued...

(d) 25 L of an unknown gas had a mass of 4.17 gram at 18 °C and a pressure of 222 kPa. Calculate the relative molecular mass of the gas.
[R = 0.0821 L·atm/K·mol] [3 marks]

(e) Silicon consists of three isotopes with the following percent abundances:

Isotope	Exact mass (amu)	Percent abundance (%)
^{28}Si	27.9769	92.12
^{29}Si	28.9765	4.79
^{30}Si	29.9738	3.09

Give the definition of isotopes and calculate the atomic mass of silicon. [3 marks]

(f) Methane is reacted with steam to produce a mixture of carbon monoxide and hydrogen following the equation:

$$CH_4\,(g) + H_2O\,(g) \rightarrow CO\,(g) + 3H_2\,(g)$$

Use the data below to calculate the enthalpy change, in kJ for the forward reaction.

Equation	ΔH (kJ)
Eq 1: $CO\,(g) + \frac{1}{2}O_2\,(g) \rightarrow CO_2\,(g)$	−283
Eq 2: $H_2\,(g) + \frac{1}{2}O_2\,(g) \rightarrow H_2O\,(g)$	−242
Eq 3: $CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(g)$	−803

[4 marks]

(g) The reaction of hydrogen gas and nitrogen gas is shown in this incomplete equation:

$$H_2\,(g) + N_2\,(g) \rightarrow$$

How many liters of hydrogen gas are necessary to react with 35 grams of nitrogen to produce ammonia at STP?
[Atomic mass: N = 14.0; H = 1.0] [3 marks]

Continued...

QUESTION 2 [30 MARKS]

(a) For the table below, answer (i) - (vi).

Solution	pH	$[H^+]$	pOH	$[OH^-]$	Acidic, basic or neutral?
1	(i)	-	11.3	(ii)	(iii)
2	-	(iv)	(v)	3.5×10^{-7}	(vi)

[3 marks]

(b) The following combinations of four quantum numbers are not allowed. Correct each set by changing only one quantum number. Then, give the orbital name for each of the following:

False quantum numbers	Corrected quantum numbers	Name of orbital (e.g.: 1*s*, 2*p*)
(i) (3, 1, -2, +1/2)		
(ii) (4, 3, +1/2, -1/2)		

[4 marks]

(c) Draw the electronic configuration, deduce the group and period and predict the block in the Periodic Table for following elements:

Element	Electronic configuration	Group and period	Which Period Table Block?
(i) ^{27}Co			
(ii) Silicon			

[6 marks]

(d) Draw the Lewis structure and complete the table below:

Compound	Lewis structure	Obey octet rule?
(i) BF_3		
(ii) $(CO_3)^{2-}$		

[5 marks]

Continued...

(e) Water is an amazing substance. With the help of a proper diagram, explain the polarity of water and how bonds are created when NH_3 molecules are dissolved in water. (Include these points: name of bonds, acid-base and conjugates) [5 marks]

(f) Consider the following reaction between nitrogen dioxide and carbon monoxide.

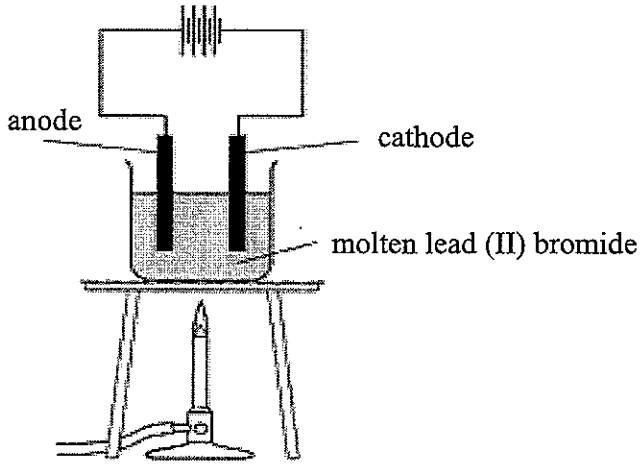
$$NO_2\,(g) + CO\,(g) \longrightarrow NO\,(g) + CO_2\,(g)$$

The initial rate of the reaction was measured at different reactants' concentrations as in table below:

Experiment	$[NO_2]$	[CO]	Initial rate M/s
A	0.1	0.01	0.328
B	0.2	0.01	2.624
C	0.1	0.02	0.328

From the data, determine each of the following:
(i) The rate law for the reaction. [3 marks]
(ii) The rate constant, k for the reaction. [1 mark]

(g) Figure below shows an experimental setup of an electrolysis tank. Calculate the number of grams of lead deposited at the end of the process.
[Atomic mass: Pb = 207; Faraday constant = 96500 C/mol e^-] [3 marks]



Current supplied : 10 A
Supplied time : 1 hour

End of question